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Policy Brief

The global hydrogen boom: Why is Japan shaping its energy plan around hydrogen energy and what interests Japan about Kazakhstan among the Central Asian countries?

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In the past few years, Central Asia has witnessed ongoing economic expansion, coupled with advancements in the business environment and a growing focus on decarbonization. Kazakhstan, in particular, relies on domestic consumption and the export of fossil fuels, presenting challenges for decarbonization efforts. However, the country possesses significant potential for blue hydrogen production due to its substantial natural gas reserves. As a result, foreign companies, predominantly international firms, are exploring opportunities for investing in green hydrogen production facilities in Kazakhstan. Foreign companies are promoting investment plans to export hydrogen to Europe. On October 27, 2022, the Kazakh government and Germany's Hylasia One signed an investment document on the construction of a green hydrogen production and distribution base in the Mangistau region of western Kazakhstan.[1]

In 2023, Japan announced its new energy strategy focused on clean hydrogen energy. Currently, the country's administration is actively involved in developing unique methods for the creation and everyday use of hydrogen energy in various industries.[2] As a nation with limited fossil fuel resources, Japan aims to diversify its energy dependence on oil and gas imports and reduce greenhouse gas emissions.[3]

Japan considers hydrogen energy strategically important for several reasons. Firstly, hydrogen is a versatile fuel that can be obtained through various conversion processes. It can be used in multiple applications, including energy storage, long-distance transportation of clean energy, and as a fuel for vehicles and industrial processes that require continuous energy supply.

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[1] JETRO. 09.06.2023. カザフスタンのグリーン戦略、外資企業による水素開発の投資計画進む (Kazakhstan's green strategy advances with foreign companies' hydrogen development investment plans), URL: https://www.jetro.go.jp/biz/areareports/special/2023/0503/85405ab8c46355cd.html#:~:text=%E3%82%AB%E3%82%B6%E3%83%95%E3%82%B9%E3%82%BF%E3%83%B3%E3%81%AB%E3%81%AF%E3%81%BE%E3%81%A0%E6%B0%B4%E7%B4%A0,%E3%81%A7%E6%8C%87%E6%91%98%E3%81%97%E3%81%A6%E3%81%84%E3%82%8B%E3%80%82&text=2021%E5%B9%B4%E3%80%81%E6%B0%91%E9%96%93%E4%BC%81%E6%A5%AD%E5%8B%A4%E5%8B%99%E3%82%92%E7%B5%8C%E3%81%A6%E3%82%B8%E3%82%A7%E3%83%88%E3%83%AD%E5%85%A5%E6%A7%8B%E3%80%82

[2] NEDO. New Energy and Industrial Technology Development Organization. 05.10.2022. 水素が次世代エネルギー社会を切り拓く！ (Hydrogen opens up a next-generation energy society!) URL: https://green-innovation.nedo.go.jp/article/hydrogen/

[3] The Diplomat. Daysuke Akimoto. July 07, 2023. URL: https://thediplomat.com/2023/07/a-look-at-japans-latest-hydrogen-strategy/ (acceded at 10.04.2024)

To promote hydrogen energy, Japan is taking steps to advance its adoption. This includes research and development efforts to improve hydrogen production methods, infrastructure development for hydrogen transportation and distribution, and the establishment of regulatory frameworks and incentives to encourage the use of hydrogen in different sectors.[4]

Central Asian countries are involved in Japan's hydrogen energy initiatives as potential partners for hydrogen production. These countries, including Kazakhstan, possess abundant renewable energy resources that can be harnessed for hydrogen production. Collaborating with these countries allows Japan to access a reliable and sustainable source of hydrogen and strengthen bilateral relations through energy trade and cooperation.[5]

Before delving further into the topic, it's important to understand the relevance of hydrogen and how it can be obtained. As noted by the International Atomic Energy Agency (IAEA), hydrogen is a fuel obtained through various conversion processes. It is a convenient form of energy that can be utilized in diverse ways, including energy storage, long-distance transportation, automotive fuel, and continuous energy usage in large-scale industries.[6]

How and from what is hydrogen taken for use as energy?

Hydrogen can be produced in a variety of ways, through electrolysis from *renewable sources*, conversion of *natural gas* and from *extraction from biomass.*

Hydrogen obtained using electrolysis from renewable sources stores energy from renewable sources well for a certain period of time in the absence of the possibility of using wind or solar energy.[7]

Conversion of natural gas - The most popular way to obtain hydrogen from natural gas is through the reformation of methane. The advantage of

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[4] White & Case. Julien Bocobza. Masahiro Tanabe. June 26, 2023. URL: https://www.whitecase.com/insight-alert/japan-hydrogen-basic-strategy (accessed at 10.04.2024).

[5] IBID.

[6] IAEA. Matthew Fisher. "More Than Just an Energy Source." September, 2020. URL: https://www.iaea.org/ru/bulletin/bolshe-chem-prosto-istochnik-energii (accessed at 10.04.2024).

[7] U.S. Department of Energy. "Hydrogen and Fuel Cell Technologies Office." URL: https://www.energy.gov/eere/fuelcells/hydrogen-and-fuel-cell-technologies-office (accessed at 10.04.2024).

converting natural gas into hydrogen is that you can use existing natural gas equipment, meaning that it is advantageous not to use new technologies.[8]

What can Japan offer to promote hydrogen energy?

Referring to Japan's Basic Hydrogen Strategy, it can be determined that the country is well-equipped for its future goals.[9]

Firstly, Japan possesses a strong industrial base and technological expertise for the production and development of high-tech resources.[10]

Furthermore, in December 2017, Japan was the first country to advocate for hydrogen energy. Since then, over 40 countries have followed this example, prompting Japan to revise its strategy. The updated Tokyo strategy sets ambitious targets. The government plans to invest 15 trillion yen over 15 years with the aim of utilizing 3 million tons of hydrogen annually by 2030, 12 million tons by 2040, and 20 million tons by 2050. This hydrogen will be used for various applications, including power generation, mobility, residential and commercial fuel cells, industrial heating, and chemicals.[11]

Secondly, according to observations from Daisuke Akimoto, an expert from one of the leading political journals, The Diplomat, Japanese companies are actively working on different paths and aspects of beneficial hydrogen production, transportation, and utilization. The development of this industry will help Japan become one of the global leaders in this field and provide greater flexibility in exporting Japanese technologies and equipment.[12]

Simultaneously, Japan's Basic Strategy for the adoption of hydrogen energy highlights its strategic importance across various aspects. It is based on

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[8] U.S. Department of Energy. "Hydrogen Production: Natural Gas Reforming." URL: https://www.energy.gov/eere/fuelcells/hydrogen-production-natural-gas-reforming (accessed at 10.04.2024).

[9] White & Case. Julien Bocobza. Masahiro Tanabe. "Japan Hydrogen Basic Strategy." June 26, 2023. URL: https://www.whitecase.com/insight-alert/japan-hydrogen-basic-strategy (accessed at 10.04.2024).

[10] IBID.

[11] East Asia Forum. Walter James. "Japan's hydrogen ambitions may do more harm than good." January 23, 2024. URL: https://eastasiaforum.org/2024/01/23/japans-hydrogen-ambitions-may-do-more-harm-than-good/ (accessed at 10.04.2024).

[12] The Diplomat. Daysuke Akimoto. July 07, 2023. URL: https://thediplomat.com/2023/09/the-japanese-companies-pursuing-a-hydrogen-economy/ (accessed at 10.04.2024).

the concept of S + 3Es (safety + energy security, economic efficiency, and environment) in response to global energy crises and the volatile situation surrounding the Russian-Ukrainian war. The country recognizes the need to establish new means of energy supply to ensure its sustainability.[13]

Our observations indicate that Japan views hydrogen as a crucial and essential resource for the continued support of their nation. Several countries are already engaged in energy transportation partnerships with Japan, and one notable example is Kazakhstan. In 1999, Kazakhstan demonstrated an interest in addressing greenhouse gas emissions by signing the Kyoto Agreement. This agreement laid the groundwork for the development of Kazakhstan's emissions trading system (ETS), which regulates emissions through market mechanisms like cap-and-trade.[14]

Kazakhstan has large reserves of natural gas and coal, as well as great potential for RES (renewable energy), and one cannot fail to take into account the potential in technological terms too. Kazakhstan and Japan have already fostered strong relations in the provision and export of natural gas via pipelines. This collaboration significantly reduces transportation costs and opens avenues for further cooperation between the two nations.[15]

Moreover, Japan's collaboration with Kazakhstan extends beyond conventional energy sources. Given Kazakhstan's vast renewable energy potential, particularly in wind and solar power, there is potential for joint ventures and cooperation in developing hydrogen production facilities powered by renewable energy sources. This would further bolster Japan's hydrogen strategy and contribute to the global transition towards a low-carbon economy.[16]

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[13] White & Case. Julien Bocobza. Masahiro Tanabe. "Japan Hydrogen Basic Strategy." June 26, 2023. URL: https://www.whitecase.com/insight-alert/japan-hydrogen-basic-strategy (accessed at 10.04.2024).

[14] Asian Development Bank. Zholdayakova, SauleAbuov, YerdauletZhakupov, DauletSuleimenova, BotakozKim, Alisa. October, 2022. URL: https://www.adb.org/publications/toward-a-hydrogen-economy-in-kazakhstan (accessed at 11.04.2024).

[15] Asian Development Bank. Zholdayakova, SauleAbuov, YerdauletZhakupov, DauletSuleimenova, BotakozKim, Alisa. October, 2022. URL: https://www.adb.org/publications/toward-a-hydrogen-economy-in-kazakhstan (accessed at 11.04.2024).

[16] Center for Economic and Financial Research. Igor Bashmakov. URL: https://cenef-xxi.ru/uploads/RUS_Vneshnyaya_torgovlya_ekonomicheskij_rost_Perspektivy_463a2412c5.pdf (accessed at 11.04.2024).

Overall, Japan's pursuit of hydrogen energy as a strategic priority demonstrates its commitment to sustainability, energy diversification, and international partnerships. By leveraging its technological expertise and collaborating with countries like Kazakhstan, Japan aims to shape the future of energy and play a leading role in the development and utilization of hydrogen as a clean and versatile energy source.[17]

Which is the priority: blue hydrogen or green hydrogen?

As mentioned earlier, hydrogen can be produced through different pathways, and each has its own nuances. Blue hydrogen has a carbon dioxide emission percentage and may not be favorably received by countries prioritizing green energy. However, green energy also has its drawbacks, such as the significant water requirement for electrolysis. While Kazakhstan has water reserves, prioritizing hydrogen over water security is not feasible. Renewable hydrogen production requires with large quantity of water, while blue hydrogen requires only 1 kg of water. These factors can be considered when determining priorities and processing methods.[18]

Therefore, both options have advantages and disadvantages in their usage. However, if we consider the most significant positive aspect of hydrogen overall, it is its cost. Currently, the most economically viable method of hydrogen production is the "blue" option, which relies on steam methane reforming of natural gas. The cost of "blue" hydrogen is approximately $1-1.9 USD per kilogram of H2 (according to IEA data from 2020). However, the addition of carbon capture and storage (CCUS) to this process, known as "blue" hydrogen, can increase the cost to $1.4-2.4 USD per kilogram of H2. It is also possible to produce "blue" hydrogen through coal gasification, which costs around $2.0-2.2 USD per kilogram of H2.[19]

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[17] Center for Economic and Financial Research. Igor Bashmakov. April, 2023. URL: https://cenef-xxi.ru/uploads/RUS_Vneshnyaya_torgovlya_ekonomicheskij_rost_Perspektivy_463a2412c5.pdf (accessed at 11.04.2024).

[18] IRENA. "Water for Hydrogen Production." December, 2023. URL: https://mc-cd8320d4-36a1-40ac-83cc-3389-cdn-endpoint.azureedge.net/-/media/Files/IRENA/Agency/Publication/2023/Dec/IRENA_Bluerisk_Water_for_hydrogen_production_2023.pdf?rev=4b4a35632b6d48899eb02bc54fd1117f (accessed at 12.04.2024).

[19] Center for Economic and Financial Research. Igor Bashmakov. April, 2023 URL: https://cenef-xxi.ru/uploads/RUS_Vneshnyaya_torgovlya_ekonomicheskij_rost_Perspektivy_463a2412c5.pdf (accessed at 12.04.2024).

In the case of producing "blue" hydrogen from natural gas, the main cost factor is the price of the natural gas itself. Kazakhstan, with some of the lowest natural gas prices in the world, may have an advantage in producing "blue" hydrogen with lower costs. The cost of producing "blue" hydrogen from coal is primarily determined by capital and operational expenses. However, the carbon capture rate also significantly influences production costs.

From a long-term perspective, reducing the capital costs of green hydrogen production requires developing local production of low-carbon technologies such as electrolysis, wind turbines and solar panels that are part of the green hydrogen supply chain.

It is important to note that high carbon prices in the future could significantly impact the competitiveness of both blue and green hydrogen, which is a big plus for both Japan and Kazakhstan.

Prospects for Uzbekistan

Uzbekistan, as a close neighbor of Kazakhstan, can take inspiration from the development of hydrogen energy and make a partial transition to it. Uzbekistan does not have the same vast reserves of natural gas as its neighbor, but despite this, it can focus on green hydrogen, leveraging its potential in wind and especially solar energy. To achieve this, Uzbekistan is making efforts to enhance its innovative capabilities in clean hydrogen development, and collaboration with neighboring countries such as Kazakhstan can help strengthen efforts and achieve a high percentage of quality hydrogen for both import and export.[20]

Based on the observations, among the three pathways for hydrogen production, the most optimal one for Uzbekistan in terms of hydrogen generation could be the development of renewable energy sources, specifically by obtaining hydrogen from wind and solar energy, as there is potential in these areas. Moreover, this green hydrogen has a high demand in operation as it does not emit pollutants into the atmosphere.

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[20] U.S.Embassy. U.S. Mission Uzbekistan. March 01, 2024. URL: https://uz.usembassy.gov/ru/usaid-energizes-uzbekistans-first-green-hydrogen-hub-ru/ (accessed at 12.04.2024)

Uzbekistan is also striving to achieve 30% of its energy production from renewable sources by 2030 and reduce carbon dependency by 2050.[21] The country is already collaborating with USAID on energy-related issues and the launch of green hydrogen initiatives. Additionally, there is a $2.2 billion investment in clean energy development, which has contributed to the installation of 2,241 megawatts of clean energy capacity throughout Central Asia.[22]

Having neighboring countries like Kazakhstan and Japan with innovative hydrogen developments provides significant opportunities for neighboring nations to independently implement their own initiatives. Central Asia possesses substantial potential for generating green and blue hydrogen, which is a promising alternative to carbon dependency. It can also serve as a secure buffer for countries with carbon dependency and limited reserves.

In conclusion, that hydrogen is a clean energy source, because it does not emit greenhouse gases or pollutants when used in fuel cells or combustion processes. Its combustion only produces water vapor, making it a potentially attractive solution for reducing carbon emissions and addressing climate change.[23]

Moreover, Hydrogen can be used in various sectors, including transportation, power generation, and industrial applications. It can be converted into electricity through fuel cells to power electric vehicles or used directly in combustion engines. Its versatility allows for integration into existing energy infrastructure and provides flexibility in meeting different energy needs. At the same time Hydrogen has a high energy-to-weight ratio, making it a potent energy carrier. This characteristic is advantageous for applications where energy storage and transportation

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[21] IEA. International Energy Agency, Uzbekistan Energy Profile. October 2021. URL: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://iea.blob.core.windows.net/assets/8c1cefe6-4c29-46b0-82fa-c524714e54a5/UzbekistanEnergyProfile.pdf

[22] Lex.uz. URL: https://lex.uz/ru/docs/6303233 (accessed at 12.04.2024)

[23] Agency for Natural resource and Energy. 2021-10-12. 次世代エネルギー「水素」、そもそもどうやってつくる？ ()How do we create hydrogen, the next generation of energy? URL: https://www.enecho.meti.go.jp/about/special/johoteikyo/suiso_tukurikata.html

efficiency are crucial, such as fueling vehicles or remote power generation.[24]

The most beneficial part for Uzbekistan is that hydrogen can be obtained through electrolysis from renewable sources such as solar, wind and biomass. Thmys allows for the creation of a renewable hydrogen economy, coupling hydrogen production with renewable energy sources and contributing to the decarbonization of the energy sector.

[24] The Asahi Shinbun. 01.08.2021. グリーン水素とは?　作り方やブルー水素との違い、問題点を解説. (What is green hydrogen? Explaining how to make it, the difference from blue hydrogen, and problems) URL: https://www.asahi.com/sdgs/article/14677144